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**Conceptual Graph Interchange
Format**

David Skipper

Bevilacqua Research Corporation

4040 South Memorial Parkway

Huntsville, Alabama 35802

Voice: 256.882.6229 ext 105

Fax: 256.882.6239

Email: davids@brc2.com

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Agenda

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- **Problems**
- **Conceptual Graphs**
- **CGIF**
- **Applicability Issues**

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Problems

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- **What Do We Really Want to accomplish?**
- **Direction Decisions**
 - **What gets standardized?**
 - **Who is a standard really for?**
 - **What will they do with it?**
 - **Who sets the standard?**
 - **Stakeholders? Competitors?**
 - **Etc, ...**
- **Knowledge Interchange Standards**

Wish List From One User's Perspective

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- **HBR? Yes, we want one of those.**
- **Human-like reasoned and non-reasoned responses**
- **What does it take?**
 - A lot of knowledge for the (non)reasoning parts
 - Cost sharing through reuse - Standard representation
 - Cooperative generation - Standard representation
 - Machine learning - Standards ?
 - Capable processing system - Standards ?
 - Balancing act between reasoning and non-reasoning components - Standards ?
- **Does this apply to non-reasoning parts?**
 - Look at some of the difficulties with reasoned part

Common Thread

Common Representation

• **Reasoned or Rational Part - knowledge**

C Knowledge Interchange Format (KIF)

- Stanford/DARPA Knowledge Systems Laboratory
- Emerging standard (BRC)

- **Conceptual Graph Interchange Format (CGIF)**

- No big name center, academic community, annual conferences
- Emerging standard (BRC)

- **XML ?**

- XML < --- > CGIF at UAH
- Are We aimed at the web?

- **Linear Form / Display Form**

- John Sowa

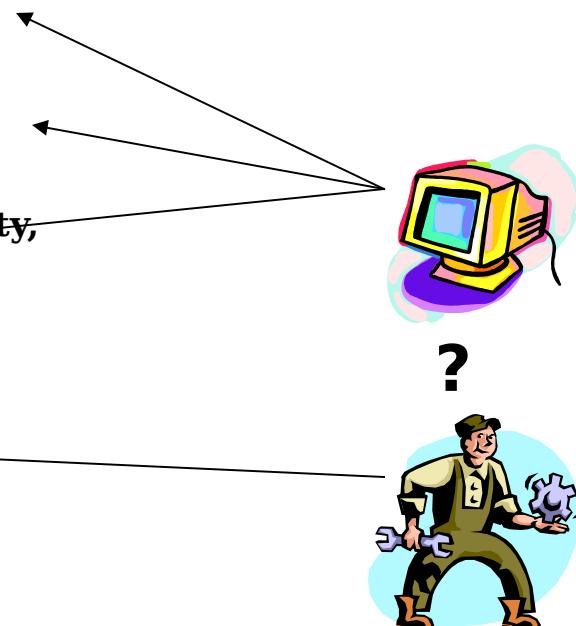
• **BUT it is NOT Knowledge. What is knowledge?**

- **Etc, etc, etc**

- **CGIF definition of knowledge**

- Concept hierarchy
- Relation hierarchy
- Outermost Context
- Catalog of individuals
- Basic manipulations identified

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ANS ?
ISO ?
W3C ?
DMSO ?

Conceptual Graphs History

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- **Original work by John Sowa, IBM Systems Research Institute. Text published in 1984 based on his work in the 1970's. Based on the Graphical Logic of Charles Peirce.**
- **A method to model knowledge with both syntax and semantics**
 - Perceptions generate conceptual graphs
 - Consists of concepts and relationships
- **Needed a way to compute, simulate, etc. Brought actors to provide**
 - Active elements or dynamic relationships
 - Message passing
 - Modularity of functions
 - Means of definition
 - Original work for database query generation
- **Applied to queries, requirements definition and numerous other tasks.**

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Conceptual Graph Symbol Key

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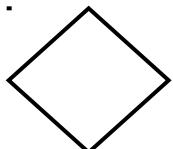
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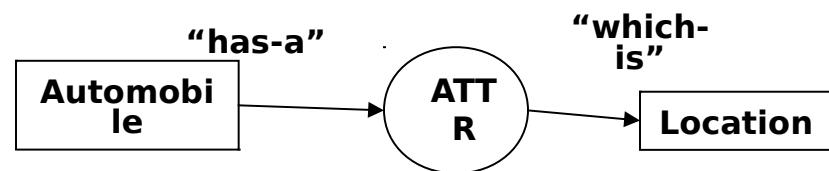
Rectangle shape means concept



Circle shape means a static relation



Diamond shape means Computation/Subroutine called an "Actor"
Provides dynamic relationships between concepts



Read in the direction arrows are pointing

Text Symbolology

Linear Form

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- [concept]
- (relation)
- <actor>
- . means end of graph

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Graph Manipulations

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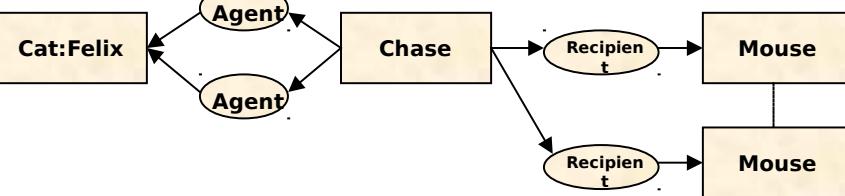


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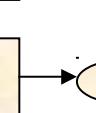
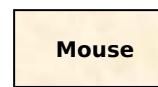
Copy



Simplify



Join



Detach

Restrict



Unrestrict



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Conceptual Graph Operations Query Graphs*

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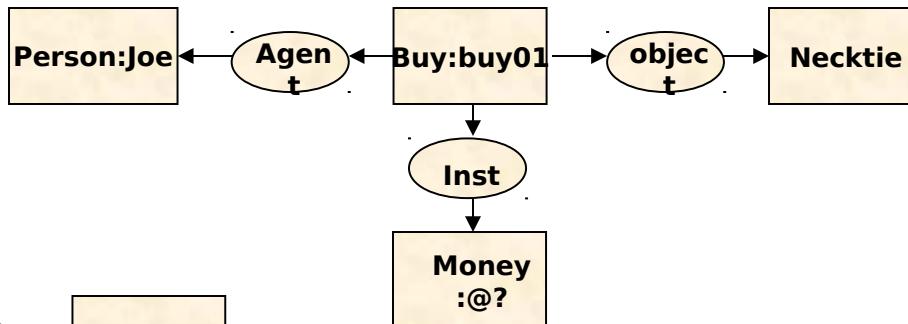
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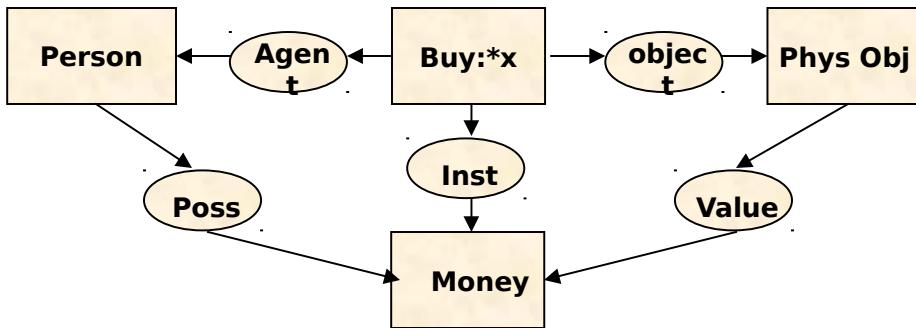
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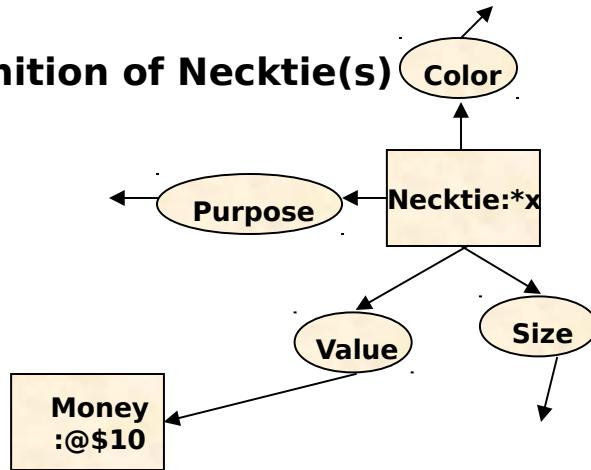
Query: How much did Joe's necktie cost?



Definition of Buy



Definition of Necktie(s)



Clark and Porter 1997

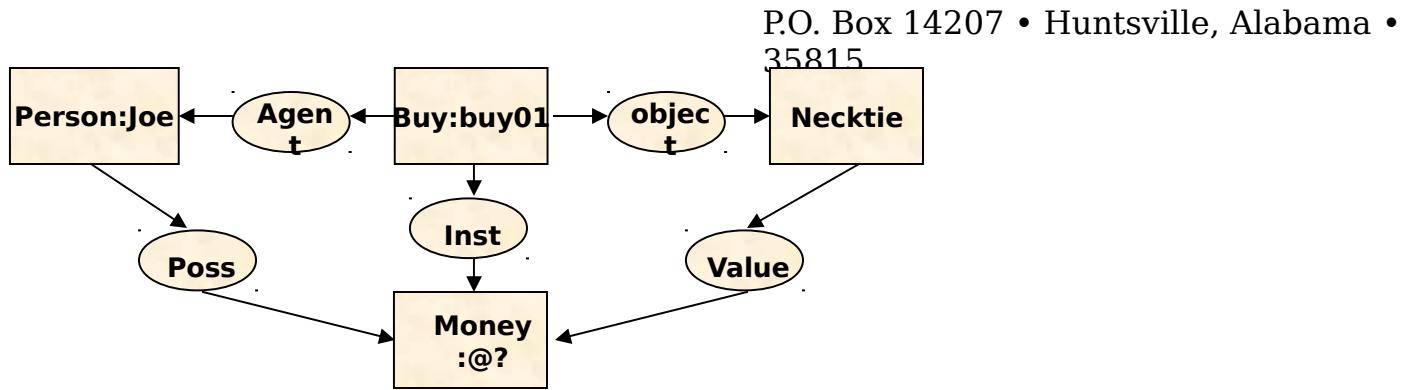
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Conceptual Graph Operations Query Graphs*

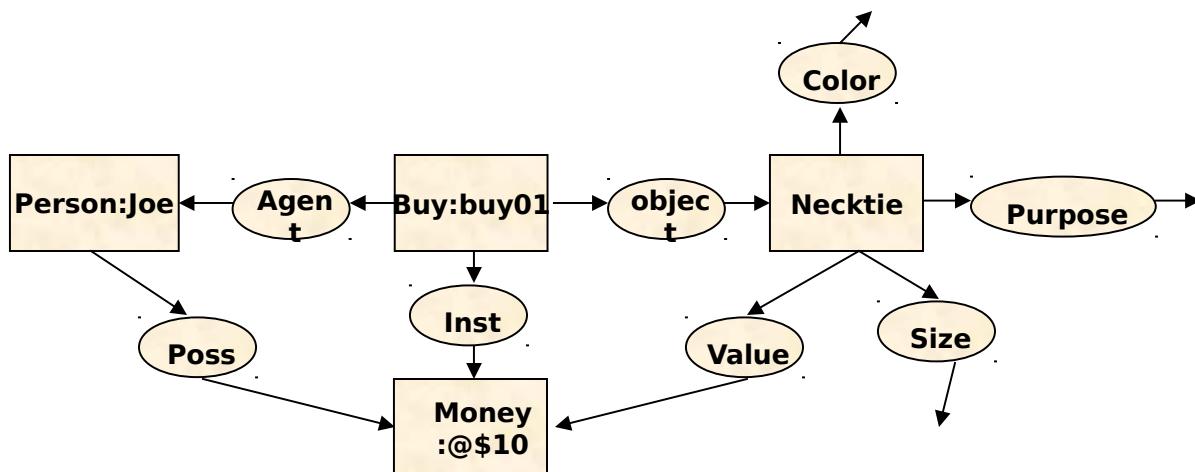
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1) Elaborate Schema



2) Classify Necktie



Clark and Porter 1997

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Why CGIF?

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- **Mechanism for computers to exchange knowledge**
 - **Text based**
 - **NOT human friendly**
 - **Ideas from Sowa's linear form**
- **Does not say how to process the knowledge**
 - **Any method can manipulate the knowledge, hopefully it contains a rational basis**

CGIF Example

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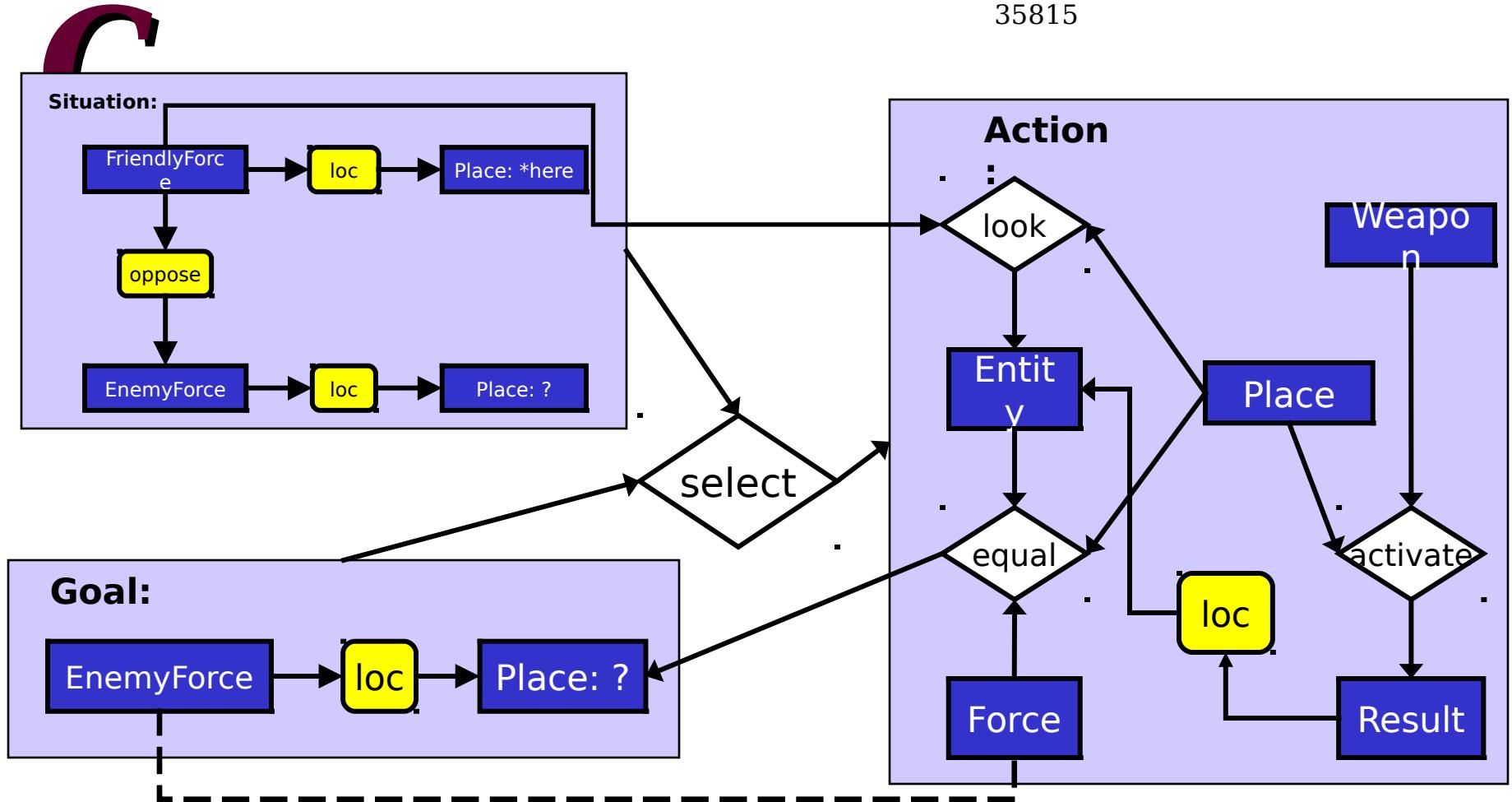
```
[TypeLabel :*t1 "FriendlyForce";{20,176,120,44}][TypeLabel :*t2 "EnemyForce";{156,176,108,37}]
[TypeLabel :*t3 "Place";{530,242,59,37}][TypeLabel :*t4 "Weapon";{242,240,78,37}][TypeLabel :*t5
"Disabled";{424,240,82,37}][TypeLabel :*t6 "Result";{340,238,62,37}][TypeLabel :*t7 "Entity";
{240,48,57,37}][TypeLabel :*t8 "Goal";{472,162,52,37}][TypeLabel :*t9 "Situation";{374,162,80,37}]
[TypeLabel :*t10 "Action";{538,158,63,37}][TypeLabel :*t11 "Force";{141,113,60,37}]
[RelationLabel :*r1 "loc";{86,205,40,37}][ActorLabel :*r2 "look";{178,129,49,37}][RelationLabel
:*r3 "oppose";{442,129,72,37}][ActorLabel :*r4 "select";{264,127,60,37}][ActorLabel :*r5
"activate";{352,127,73,37}][RelationLabel :*r6 "has";{26,205,45,37}][RelationLabel :*r7 "attr";
{78,125,42,37}][ActorLabel :*r8 "equal";{576,141,57,37}]
[Situation :*s1[FriendlyForce :*f1;{100,54,115,37}][EnemyForce :*e1;{106,242,108,37}][Place :*p1;
{440,70,59,37}][Place :*p2;{448,236,59,37}][Weapon :*w1;{458,182,78,37}](oppose ?f1 ?e1;
{138,156,72,37})(loc ?f1 ?p1;{294,58,40,37})(loc ?e1 ?p2;{312,252,40,37})(has ?e1 ?w1;
{320,180,45,37})<activate ?p1 ?w1;{564,132,73,37}>;{51,73,80,37}][Action :*a1[Force :*f1;
{88,103,60,37}][Weapon :*w1;{338,166,78,37}][Place :*p1;{128,222,59,37}][Result :*r1;
{458,316,62,37}](has ?f1 ?w1;{224,132,45,37})<activate ?p1 ?w1 ?r1;{316,262,73,37}>;
{299,143,63,37}][Goal :*g1[EnemyForce :*e1;{99,211,108,37}][Disabled :*d1;{460,206,82,37}](attr ?
e1 ?d1;{326,220,42,37});{59,207,52,37}][Action :*a2[Force :*f1;{38,21,60,37}][Force :*f2;
{342,312,60,37}][Entity :*e1;{66,123,57,37}][Place :*p1;{344,122,59,37}][Weapon :*w1;
{544,22,78,37}][Result :*r1;{532,242,62,37}][Place :*p2;{38,298,59,37}]<look ?f1 ?p1 ?e1;
{176,55,66,34}>(loc ?r1 ?e1;{364,200,40,37})<activate ?p1 ?w1 ?r1;{452,118,73,37}><equal ?e1 ?f2 ?
p1 ?p2;{170,232,57,37}>;{590,180,63,37}][Situation :*s2[FriendlyForce :*f1;{46,84,115,37}]
[EnemyForce :*e1;{68,296,108,37}][Place :*p1;{398,102,59,37}][Place :*p2;{444,268,59,37}](oppose ?
f1 ?e1;{88,176,72,37})(loc ?f1 ?p1;{258,92,40,37})(loc ?e1 ?p2;{284,278,40,37});{373,76,80,37}]
[Goal :*g2[EnemyForce :*e1;{87,163,108,37}][Place :*p1;{464,174,59,37}](loc ?e1 ?p1;
{300,186,40,37});{384,260,52,37}]<select ?s1 ?g1 ?a1;{167,145,60,37}><select ?s2 ?g2 ?a2;
{456,180,60,37}>]
```

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CGIF Example Part 2

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Issues Utility

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- **Standard, but no big name backers**
- **Knowledge tools and systems to read and write CGIF**

Issues Reasoning

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- **Reasoning is evolution of the graph, nodes or topology, over time.**
- **Perception (matching) of various types**
- **All the other graph operations**

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Issues Fundamental Knowledge Sets

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- **Common sense human knowledge about people and things, i.e the cultural background**
 - Substantial for even one culture
 - Like emotions, culture influences what you perceive and the courses of action permitted.
 - How do cultural systems interact?
 - How do emotions interact? With Knowledge? With Culture?

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Lessons Learned

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- **Representation is not enough**
 - Standardized
 - Used
- **Manipulations and interactions defined**